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with refractors only. In the case of the *Orion* nebula, the amount of nebulosity shown in the frontispiece is easily obtained with an exposure of five minutes, though at the expense of all detail in the central parts. The Huyghenian and adjoining brighter regions can be photographed in thirty seconds. Comparison with earlier results obtained with the photographic lens of the great refractor (33 inches aperture) shows that with the Crossley reflector more nebulosity is shown in ten minutes than can be obtained with the refractor in three hours. The great superiority of the reflector indicated by this test is due partly to its much greater angular aperture, and partly to the fact that the thick lenses of the refractor strongly absorb the photographically active rays of the nebula, which, as shown by the spectrum, are largely of quite short wave-lengths.

It should be added that the large mirror of the Crossley reflector has not yet been resilvered. It has been repolished, but the surface is spotted and not nearly as bright as it can be made.

J. E. K.

SECOND NOTE ON THE MINOR PLANET DQ.

When the little planet DQ was discovered last August by Dr. WITT, at the Urania Observatory, Berlin, it was at once noted that its motion was very rapid, thus indicating a marked difference between its orbit and those of the other asteroids. This has been abundantly verified, first by the elements of its orbit computed soon after its discovery by Dr. BERBERICH, and, later, by those obtained by Messrs. CHANDLER, FAYET, HUSSEY, MILLOSEVICH, and RUSSELL.

DQ has the shortest periodic time of any asteroid known. While all the others require from 3.0 to 8.4 years to complete a revolution about the Sun, it requires only 643 days, or 1.76 years. In the course of forty-four years it makes very nearly twenty-five sidereal revolutions; so that after this interval it and the Earth occupy again at the same time very nearly the same positions in their orbits, and therefore sustain to each other nearly the same general relations.

The orbit of DQ is to be classed with those having rather high eccentricities. On the average, only one asteroid out of seven has a higher value of this element. On account of the magnitude of its eccentricity, the distance of DQ from the Sun has a range of over 60,000,000 miles, the minimum being a little

more than 105,000,000, and the maximum about 165,600,000. At perihelion it approaches within 14,000,000 miles of the orbit of the Earth, and at aphelion it recedes 24,000,000 miles beyond the mean distance of *Mars*.

Great interest centers in the planet DQ solely on account of the nearness with which it approaches the Earth, and the use that can be made of it by reason of this circumstance in determining the value of the solar parallax and those of related astronomical constants with a higher degree of precision than has hitherto been attained.

It will be remembered that many methods have been proposed for determining the value of the solar parallax, or its equivalent, the mean distance of the Earth from the Sun. The attempts to obtain the value of this fundamental constant, the unit of astronomical distances, by direct means, have proved absolute failures. All the methods giving values at all acceptable have been indirect. In these the measurements are made, not upon the Sun, but upon other bodies, and for the determination of quantities which are known functions of the Earth's distance from the Sun.

Among such methods, the observations of the transits of *Venus*, made at widely separated stations, promised great accuracy. But, unfortunately, there were unexpected difficulties, and in many cases, even after the observations had been obtained, there were uncertainties as to just what had been observed. On this account, these observations have received a variety of interpretations, and in the hands of different computers have yielded various discordant values of the solar parallax.

Gravitational astronomy has furnished several methods of obtaining the solar parallax, but always in connection with the determination of other astronomical constants, or in some way more or less dependent upon them. Thus, it may be deduced from the lunar inequality of the Earth's motion, from the parallactic inequality of the Moon, from the mass of the Earth as derived from the secular variations of the elements of the interior planets, etc. It may also be obtained by combining the measured velocity of light with the light equation, and by combining the velocity of light with the constant of aberration. But all these constants are in themselves subject to uncertainties, and it is highly desirable to obtain the solar parallax independently of them, and then to use it, if need be, in verifying their values.

The most accurate independent method of obtaining the value of the solar parallax that has been practically tested is the measurement of the displacements of the nearer asteroids among the stars about the time of opposition. *Mars* has been used for the same purpose; but on account of its large disk and other peculiarities, it is not easy to measure its distance from the stars and secure results free from large systematic errors. On the other hand, the asteroids have precisely the same appearance as the fixed stars, and submit to measurement with like facility and like precision. In parallax determinations they have already furnished results among the best.

Concerted observations were made in 1888 on the planet *Iris*, and in 1889 on *Victoria* and *Sappho* at the Cape of Good Hope, in the southern hemisphere, and, in part, at New Haven, Göttingen, Leipzig, Bamberg, and Oxford, in the northern hemisphere, from which the following very accordant values of the solar parallax have been derived:—

	Mean Solar Parallax.	Probable Error.	Weight.
From <i>Victoria</i> ,	8".8013	0".0061	2.69
From <i>Sappho</i> ,	8 .7981	0 .0114	0.77
From <i>Iris</i> ,	8 .8120	0 .0090	1.23

These separate values have an extreme variation of only 139 ten-thousandths of a second of arc, or the angle which a foot rule would subtend at a distance of 2,810 miles. This sufficiently indicates the precision attainable by this method. We are not to suppose, however, that the results here quoted have the accuracy demanded by modern astronomy. This may be appreciated the better, when we remember that a difference of only 0".0139 in values of the solar parallax corresponds to nearly 148,000 miles, or to considerably more than half of the distance from the Earth to the Moon.

The observations from which the above values of the solar parallax were derived were made when the planets *Iris*, *Victoria*, and *Sappho* were not far from a unit of distance from the Earth. At the most favorable oppositions, those occurring about the 20th of January, the distance of the new planet DQ is only about one seventh as great. If observations be made upon it in the same manner, and if in them there is practical freedom from systematic errors, they should furnish a value of the solar parallax with the uncertainties correspondingly diminished.

From observations of August 15th, September 27th, and November 11th, I have computed the following new elements of the orbit of the planet DQ :—

Epoch 1898. August 31.5, Gr. M. T.

$$\begin{array}{l} M = 221^{\circ} 33' 29''.1 \\ \omega = 177 \ 41 \ 21 \ .0 \\ \Omega = 303 \ 30 \ 19 \ .2 \\ i = 10 \ 49 \ 33 \ .5 \\ \phi = 12 \ 52 \ 16 \ .1 \end{array} \left. \vphantom{\begin{array}{l} M \\ \omega \\ \Omega \\ i \\ \phi \end{array}} \right\} 1898.0$$

$$\log a = 0.163710$$

$$\mu = 2015''.773$$

$$\text{Period} = 642.929 \text{ days}$$

For my observation of January 3, 1899, these elements give the following residuals :—

$$\text{O—C: } \Delta \alpha = + 0''.36, \quad \Delta \delta = - 0''.1$$

This observation was obtained fifty-five days after the last observation upon which the elements were based.

In the *Astronomical Journal*, No. 452, Dr. CHANDLER has given the following elements :—

Epoch 1898. August 31.5, Gr. M. T.

$$\begin{array}{l} M = 221^{\circ} 35' 45''.6 \\ \omega = 177 \ 37 \ 56 \ .0 \\ \Omega = 303 \ 31 \ 57 \ .1 \\ i = 10 \ 50 \ 11 \ .8 \\ \phi = 12 \ 52 \ 9 \ .8 \end{array} \left. \vphantom{\begin{array}{l} M \\ \omega \\ \Omega \\ i \\ \phi \end{array}} \right\} 1898.0$$

$$\log a = 0.1637876$$

$$\mu = 2015''.2326$$

$$\text{Period} = 643.10 \text{ days}$$

This is the third system of elements of DQ published by Dr. CHANDLER. He has obtained them by correcting his previous elements so as to represent the positions of the planet derived from photographic plates taken at Arequipa in 1896. The planet has also been found upon plates taken in 1893 and 1894, and its positions for certain dates in these years have been obtained from them. These positions will be very useful in an early determination of more accurate elements of the orbit.

The longitude of perihelion of DQ is approximately 121° . The heliocentric longitude of the Earth has this value about the

21st of January. Therefore, when an opposition of the planet occurs at this date, its distance from the Earth will be a minimum, and the planet will be most favorably situated for the determination of the solar parallax.

According to my elements, the next date of perihelion passage is May 6, 1899. Assuming the periodic time of the planet to be exactly 643 days, which is very nearly the mean of the two values given above, and neglecting perturbations, I have found the following approximate dates of perihelion passage from 1850 to 1938, or through two complete cycles, so far as relates to the motion of the planet with reference to that of the Earth.

It will be noted that the opposition 1901 will be the most favorable for determining the solar parallax of any until those of 1923, 1931, and 1938. It is unfortunate that the planet was not discovered some years ago, so that parallax observations could have been made at the very favorable opposition of 1894.

Jan.	19, 1850	Jan.	23, 1894
Oct.	26, 1851	Oct.	28, 1895
July	28, 1853	Aug.	1, 1897
May	2, 1855	May	6, 1899
Feb.	3, 1857	Feb.	8, 1901
Nov.	8, 1858	Nov.	13, 1902
Aug.	12, 1860	Aug.	17, 1904
May	17, 1862	May	22, 1906
Feb.	19, 1864	Feb.	24, 1908
Nov.	23, 1865	Nov.	28, 1909
Aug.	28, 1867	Sept.	2, 1911
June	1, 1869	June	6, 1913
March	7, 1871	March	11, 1915
Dec.	8, 1872	Dec.	13, 1916
Sept.	12, 1874	Sept.	17, 1918
June	16, 1876	June	21, 1920
March	21, 1878	March	26, 1922
Dec.	24, 1879	Dec.	29, 1923
Sept.	27, 1881	Oct.	2, 1925
July	2, 1883	July	7, 1927
April	5, 1885	April	10, 1929
Jan.	8, 1887	Jan.	13, 1931
Oct.	12, 1888	Oct.	17, 1932
July	17, 1890	July	22, 1934
April	30, 1892	April	24, 1936
Jan.	23, 1894	Jan.	27, 1938

DQ has recently received the name *Eros*.

Mt. HAMILTON, January 20, 1899.

W. J. HUSSEY.